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## The Feasible Analysis of Business Operation Model for Power Fiber to the Home

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### Abstract

This paper discussed the business model for power fiber to the home (PFTTH) project, in order to accelerate the spread and development of PFTTH construction and serve the national “Three Net Integration” strategy. By analyzing the advantages and disadvantages of business participants for the PFTTH project, this paper proposed two feasible business models from the point of electric power company, and then built an operable model to analyze the residents’ pay ability and influence on operating earnings with different size of communities. Though analysis, equipment depreciation is the main effective factor, when residents’ population is small, or cost recovery period is relatively short. Furthermore, simple business type and occupancy rate largely influenced the profit.

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### 1. Introduction

In 2009, after established the strategy of strong smart grid construction, State Grid Corporation of China actively carries out many relative researches and projects, and makes Power Fiber to the Home (PFTTH) technology as an important project in the power distribution part of smart grid.

Nowadays, PFTTH services have largely developed in many advanced countries. The “E-Japan” plan<sup>[1-3]</sup>, worked out by the Japanese government in 2003, made great efforts on developing power fibre networks. The Tokyo Electric Power Company (TEPCO) and the Kansai Electric Power Company (KEPCO) operated the telecommunication business by the way of self-construction and self-management. Using the PFTTH, they could offer high quality broadband services, such as fibre platform renting, data

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center, IP telephone, etc. In Singapore, established in 2008, OpenNet<sup>[4]</sup> is a joint venture between four partners - Axia NetMedia (Axia), Singapore Telecommunications (SingTel), Singapore Press Holdings (SPH) and Singapore Power Telecommunications (SPT). OpenNet carries on its shoulders the heavy responsibility of building, managing and operating a truly open high quality fibre platform for Singapore's Next Generation Nationwide Broadband Network (Nest Gen NBN). In 2009, the strategy prompted the network of 30 percent coverage rate in the whole country.

In China, driven by the "863" high-tech programs in 2004, Wuhan, Chengdu and other places established test networks for the fiber to the home (FTTH). In October 2005, the National "Eleventh Five-Year's Plan" proposed to promote the "Three net integration" construction, for which could be technically supported by the FTTH. China Telecom Corporation had carried out some pilot projects in Wuhan, Beijing, Shanghai and Guangzhou; China Netcom Corporation had carried out the tests in the central business districts and high-grade residences of Beijing and other places<sup>[5]</sup>. In 2009, with the aim of domestic independent technique innovation, the State Grid Corporation made a major breakthrough on the key technology of PFTTH, and successfully developed the world's first optical fiber composite insulated power cable for low voltages (OPLC)<sup>[6]</sup>. In 2010, the first pilot projects of PFTTH were built in Shanghai, Chongqing, etc., while the second PFTTH pilot projects have begun to carry out for 36,740 families in 23 cities of 14 provinces. Currently, Beijing, Zhejiang, Shenyang, Chongqing, etc., are working with the public network operators for consultation of strategic fellowship.

At present, the state's "Three net integration" strategy has entered into the construction stage. The trend of the public network, the copper network developing into the optical network, is irreversible, which provides an enormous market opportunity for the development and application of power fiber to the home.

## **2. The Demand Analysis of PFTTH Business Cooperation**

The participants of PFTTH business mainly involve the electric power company, public network operators (telecommunications, radio, television operators, etc.), value-added service providers and other stakeholders.

### *2.1. Electric Power Company*

In order to maintain safe and efficient operation and reduce the operating fee, the electric power company needs to provide two-way interactive electricity services by collecting enough electrical information using the PFTTH "in the last mile". Electric power company has the inherent advantage on owning the resources of power cable channels and power lines to build information roads into every household, so it is able to construct optical fiber cable at the same time as laying the power lines, which can reduce the construction costs and avoid duplicate and across cabling.

### *2.2. Public Network Operators*

The public network operators, as "Three net integration" service providers, not only have the plentiful business resources and professional operation teams, but also have rich experience on developing value-added service market. The growth network demand of high-bandwidth and rich-content forces public network operators to seek new business market and increase profit margins in the competition of the telecommunication field.

Until now, China Telecom Corporation (CTC) and China Unicom Corporation (CUC) have 90% share of broadband users. The CTC has a large network coverage in the southern of China; the CUC dominants

in the northern of China. China Mobile Corporation has strong advantages on mobile base stations occupation, mobile coverage and related business development, but it has no resources of backbone network and user access network. The demand of traditional fixed-line voice business from basic telecom operators has declined, while the need of broadband access services has substantially increased. The three major telecom operators have carried out different ways to run IPTV business with the operators who own IPTV licenses, their FTTH projects are also in its infancy.

### *2.3. Value-added Service Providers*

The value-added service providers can provide convenient and colorful information services to the community residents. Value-added information service involves the services that can offer property service information, community activities information, information dissemination, advertising, and other functions, which controlled by the intelligent interactive terminals though fiber-optic network. Besides, within the family, the terminal can achieve the functions of information collection, household power management, home appliance control, three meters' information (electricity, water, gas) collecting, home security monitor, etc.

## **3. Business Operation Modes**

Power fiber to the home may take two operating modes: one is resource rental model. The electric power company invests OPLC cables and telecommunication equipment, and then lends to the network operators. The other one is full-service business model. The electric power company can be independent or join with the relative companies to found an operator company to carry out commercial operations. Currently, State Grid Corporation of China has owned Internet Content Provider (ICP) certificate, with the qualification to carry out Internet business, such as the Internet access and value-added information services; but the company has not yet qualified IPTV and voice services, the services of which needs to cooperate with the infrastructure operators. The electric power company can obtain the benefits by sharing revenue with the partners.

For the electric power company, because the resource rental model is just the communication channel lease, there is no policy barrier, and the requirements of operation and maintenance are relatively simple; full-service business model can grasp the priority in the information services, and cooperate intensively with the public network operators in "Three net integration" business. IPTV and voice services currently exists the policy barriers and the electric power company lacks the relative experience of organizing, operation, and maintenance.

In the initial development stage of PFTTH project, the electric power company has no media information sources and telecommunications business qualification, so it has to cooperate with the public network operators to operate the resource rental model.

Next, the electric power company, along with the public service providers and value-added service providers, expand the scale of business operations to increase revenue. Besides the electric power company, the PFTTH project involves the participation of estate developers, residents, network operators and other stakeholders. The electric power company needs to deal with a wide range of issues with these partners, such as cost-sharing, cooperative mode, maintenance responsibilities, communication channel management. Therefore, it is better that the company sets up a professional sub company, which is responsible for the provincial electric power company, clients, service providers, and equipment providers. The operation function is clear, so the target is.

When the PFTTH project has widely developed, the electric power company can set up an independent operator corporation to independently form a large-scale operation and maintenance team, carry out

value-added information services and Internet access services, and create new co-operation business with the network operators.

#### 4. The Business Profitability Analysis of PFTTH

According to the respective business expertise of the electric power company and public network operators, when starting to promote the PFTTH project, electric power company should make good use of the power channel resources to construct the OPLC cables and Ethernet Passive Optical Network (EPON)<sup>[5]</sup>, and develop the value-added services. Communication system maintenance can be in the charge of public network operators. The public network operators and public service companies may provide business resources and professional teams to provide business and technical support, and share profits with the electric power company to achieve win-win cooperation.

For the electric power company, in order to analyze the profitability of the cooperative business, the following text will establish a realistic model of business income and expenditure in different scale of residents. The prices and fees appeared in the following text are valid, based on the public networking operators' former relative experiences. The charges shown as follows are according to the contracts with the local public services' operators, such as CUC, CTC, Provincial Bureau of Radio, Film and Television (BRFT), etc.

##### 4.1. An Income and Expenditure Model

According to the current cooperative contracts of public operators, the expected income that electric power company can charge from the citizens who are willing to accept the basic services (Internet, CATV and telephone) and value-added business services in the medium-sized cities is shown in Table 1.

The electronic advertising and video on demand service are two value-added services, the expenditure from which is not fixed. Advertising can be divided into three fee types according to the different needs. The long-term advertising displaying for more than one month charges 3,000 yuan for each one; the medium-term advertising displaying for more than one week, but less than one month, charges 1,500 yuan for each one; the short-term advertising displaying within a week, charges 500 yuan for each one. The frequency rate of the three types' ads is 1:2:7 ratios every a month. If there are 20 ads released per month in an intelligent community, the average monthly fee a household need to pay will be 15 yuan. In addition, on the average, each household pays 2 yuan per month on video on demand services, because the electric power company shares 50% income of monthly fee (4 yuan/month/ household).

Table 1. The expected income (yuan/month/household) of electric power company

Business	Income share
Broadband Internet	15*
Telephone	2
IPTV	20**
Electronic Advertising	15
Water Data Collection Purchasing	1
Gas Data Collection Purchasing	1
Video on demand	2
Other value-added services	2

\*: The electric power company shares 30% Broadband Internet's income of monthly fee (50 yuan/month/household).

\*\*\*: The electric power company shares 40% IPTV income of monthly fee (50 yuan/month/household).

The operating expenses of the electric power company include income tax, depreciation of equipment, value-added business' operation and maintenance personnel cost, and maintenance expense. The tax and maintenance expense occupies 8.56% of the business's income. When calculating the depreciation of equipment, the lifetime of the communication facilities should be considered. The lifetime of OPLC cable is 25 years, and the lifetime of the fiber optic networking equipment and value-added service's master station is 10 years<sup>[5]</sup>. Basing on these data, the equipment depreciation per year can be calculated from the total investment.

Value-added services bases on PFTTH need to construct master station, security isolation unit and other equipment. Currently, the investment of a community master station at a large-scale community (1000 households and above) needs 100 million yuan, while the one at medium-scale community (less than 1,000 households) is 80 million. In the meantime, the value-added business' operation and maintenance personnel cost is 30,000 yuan each year for one person.

#### 4.2. A Community Model

Allow the residents in a community need telephone, cable TV, broadband Internet and other basic services, and are interested in new services, such as community value-added services.

Since the residential occupancy rate increased year by year, set the previous five years of occupancy rates respectively in conservative and optimistic views, according to the report [7], as in Table 2. After the fifth year, the occupancy rate remains unchanged.

Table 2. Residential occupancy rate (%) of the previous five years

Level	1st year	2nd year	3rd year	4th year	5th year
Conservative	50	70	90	95	98
Optimistic	70	90	95	98	100

Table 3. Value-added service's occupancy rate (%) of the previous three years

Level	1st year	2nd year	3rd year
Conservative	30	50	80
Optimistic	50	80	100

For the value-added service, the occupancy rate of the previous two years is low because of the decoration of the new residents, so it can be ignored. The conservative and optimistic occupancy rate was set from the third year to the fifth year, as in Table 3. After the fifth year, the occupancy rate remains unchanged.

#### 4.3. Sensitivity Analysis of Household Pay Capacity

When the amount of investment is fixed, the next is analyzing the fee that the electric power company needs charge from each household, in order to return all the investment within 5, 10, 15 or 20 years. Set the community size is 1,000 households, the total investment is 2 million yuan, and the investment ratio of OPLC cable and networking equipment (OLTs, ONUs, splitters, etc.) is 1:2. When the payback period increases 10 years, the optical networking equipment need to renew, this leads to the increasing of expenditure in calculating.

Setting the annual fee got from the household remains the same, because the residential occupancy rate changed in previous five years, so the annual income of the community is different. After the first five years, the annual income of the community will remain the same as the fifth year's. Setting  $t_1x, t_2x, \dots, t_Nx$ , ( $i = 1, 2, \dots, 20$ ), as the annual cost of each household,  $x$  is the charge base,  $N$  is the

total number of households for the district, then the total expenditure  $S_T$  of the project in  $T$  years is as follows:

$$S_T = 8.56\%(t_1 + t_2 + \dots + t_T) \times N + 30000T + S_0 \quad (1)$$

where  $S_0$  is the cost of once investment, and the depreciation of equipment ignores under this condition.

The total amount of fee  $S_N$  from all the households is as follows:

$$S_N = (t_1 + t_2 + \dots + t_T) \times N \quad (2)$$

When reached the payback period,  $S_T$  equals  $S_N$ .

By this analysis, when the amount of investment is fixed, the curve of the annual charge base  $x$  within the payback period was shown in Figure 1.

From Figure 1, the longer the payback period is, the less the amount of fee from households is. As the payback period is no more than 10 years, the change tendency of household expenditure is fast, while the payback period is more than 10 years, the change tendency in household's spending will be slow. However, under the condition of 15-year and 20-year payback period, the communication equipment needs be updated after 10-year lifetime, and the new equipment cost will finally increase the household's expenditure.

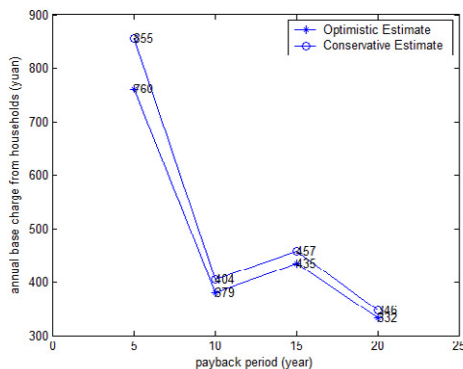


Fig. 1. The curve of the annual charge base from households within different payback periods under the fixed investment.

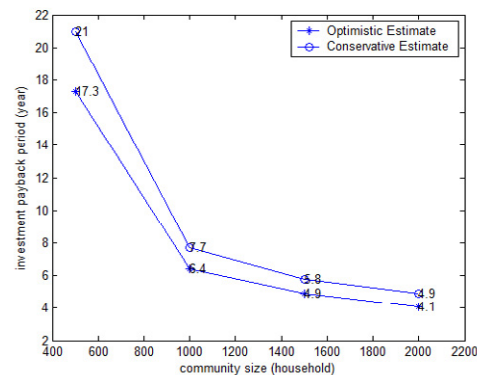


Fig. 2. The curve of the investment payback period along with the different community sizes under the fixed investment.

#### 4.4. Sensitivity Analysis of Community Size

When the amount of investment is fixed, consider the payback period in different size of communities. Set the total investment is 2 million yuan, and the investment ratio of OPLC cable and networking equipment (OLTs, ONUs, splitters, etc.) is 1:2, which can be converted into the depreciation of equipment. The community size sets as 500, 1000, 1500, 2000 households, respectively.

Basing on the income and expenditure model, the equations defined as follows:

- Annual income = Annual income of “Three net integration” services + Value-added services revenue;
- Annual expenditure = Income tax + Depreciation of equipment + Value-added business' operation

and maintenance personnel cost + Maintenance expense;

- Value-added service income = Electronic advertising revenue + IPTV revenue + Video on demand revenue + Water, gas data collection purchasing income + Other value-added services' revenue;
- Depreciation of equipment = Cable cost / 25 years + Optical networking equipment cost / 10 years + Value-added services equipment cost / 10 years;
- Annual net income = Annual income - Annual expenditure.

By this analysis, when reached investment payback period, the total income should equal the total expenditure. Under a fixed amount of investment, the curve of the investment payback period along with the different community sizes was shown in Figure 2.

From Figure 2, during the lifetime of equipment, under the fixed investment, the larger the household size is, the shorter the investment payback period is. When the community is small, the large amount of investment will lead to the extra cost for updating equipment after its expiration of the 10-year lifetime, which will require a longer payback period. Especially under the 500 households' condition, when the equipment updated once, it needs to take 21 years to recover in the conservative estimate. In fact, at this situation, a renewal of equipment should be considered, which brings about that the payback period will be more than 25 years. At this time, another fiber optic cable needs to be reconstructed. Therefore, the investment will be snowballed and the payback period will be even much longer. It is better to combine several communities in one PFTTH project and control the investment payback period within 10 years.

In conclusion, when the household size is small or the payback period is short, there is a big estimate gap in between the conservative view and the optimistic view. The main influence of which is the equipment depreciation cost. In addition, as the investment cost declined, various of value-added services will quickly receive benefits and have a direct impact on the recovery of investment.

## 5. Conclusion

Nowadays, because of the high cost of construction, some innovative measures, such as centralizing procurement of equipment, increasing the scale of procurement, running professional operative company, will largely reduce the operating cost and household fee in the PFTTH project. The analysis of business model for power fiber to the home can explore the key affect factors in the new business, and make clearly about how to develop corporative relationship sustainable between the electric power company and information service operators, in order to boost the popularity of PFTTH development and serve to the country's "Three net integration" strategy.

## References

- [1] H. Shinohara, "Broadband access in Japan: rapidly growing FTTH market," *IEEE Commun. Mag.* 43, 2005, pp.72–78.
- [2] S. Ikeda, H. Yoshinaga, and T. Sugawa, "Recent FTTH deployment focused on video service of NTT," in *Proceedings of the European Conference on Optical Communication* (2006), Mo3.5.1.
- [3] H. Aoyama, H. Tanaka, Y. Hoshino, and Y. Oda, "Optical wiring technology for a service ready and low cost FTTH service," *NTT Tech. Rev.* 3, 2005, pp.33–37.
- [4] T. Nakajima, T. Terakawa, M. Toyonaga, and M. Kama, "Development of optical connector to achieve large-scale optical network construction," Presented at the *55th International Wire and Cable Symposium, Inc./Focus* (IWCS, 2006), pp. 439–443.
- [5] Tao Zhi-yong, Cai Jin, "Prospects and development on FTTH technology in China", *Information Technology*, 2011.4
- [6] J. Liu, J. Wang, N. Li and Z. Chen, "Research and Validation of the Smart Power Two-Way Interactive System Based on Unified Communication Technology", *Advances in Swarm Intelligence*, Volume 6729/2011, pp. 434–440.
- [7] Bocheng Yin, "Problem's crux – house's business is much more like the stock's", *Economic Outlook*, vol. 3, 2010, pp. 36.